

Early Neonatal Health Ratio – A New Approach

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ABSTRACT:

Introduction: Early neonates are more prone towards infections and deaths. A new concept called Early Neonatal Health Ratio (ENHR), ENHR scale and ENHR analysis are discussed with an application to inborn early neonates of Cheluvamba Hospital, Mysore.

Material and Method: A retrospective study was planned. A total of 24,578 live births were monitored for their morbidity status from September, 2011 to June, 2013 in the hospital and the data were taken with the Institutional ethics committee permission. Monthly wise number of morbidity causes was detected. Sample 1 is the September 2011, Sample 2 being October 2011 and so on. A new approach to analyze and detect the community based health status will be discussed in this paper. The combination of ENHR graph, Check sheet and Pareto chart is called ENHR analysis.

Results and conclusion: The mean ENHR in this study is 0.1131. 60% of samples lie in better health region. All samples have little variability around the mean ENHR indicating the early neonatal community in the hospital has lesser issues. HIE/Moderate-severe birth Asphyxia (33%) is the major contributor to the morbidity profile. A formula for ENHR is derived and given along with the ENHR analysis. The range for ENHR is detected and is always greater than 0. The value 0 indicates healthy community, (0,1) indicates moderate health and greater than 1 indicates diseased community.

INTRODUCTION:

The childhood morbidity is less routinely measured^[1]. Also early neonates are more prone for severe infections and deaths^[2]. It is customary to measure the health status through mortality and morbidity rates. In the case of mortality, the deaths are used to analyze the health status as deaths are easier to measure. However, issue with death is, it doesn't provide complete information on health. In the case of morbidity, though disease provides better health information than death, it is the cause of the disease that provides the best information. Suppose the morbidity cause in an early neonate community as a defect or nonconformity then the defect or nonconformity data are always more informative than fraction nonconforming data, because there will usually be several different types of nonconformities i.e. morbidity causes. Analyzing the nonconformities by type, it is often possible to gain considerable insight into their cause^[3,4]. There is a need in the medical field for a new indicator of health that estimates the health status even better. In view of this the purpose of the study is to establish a new health indicator concept for early neonate community. The idea being here is that the causes are more informative than deaths or diseases which have been totally neglected so far. As a result this study is planned with the following objectives given in specific learning format for establishing:

1. a new concept called Early Neonatal Health Ratio
2. the range for ENHR
3. the procedure for ENHR analysis and its interpretation
4. the inborn early neonatal health status of Cheluvamba Hospital, a teaching hospital associated with Mysore Medical College and Research Institute, Mysore through ENHR analysis

Key words: Early neonatal health ratio, ENHR graph, ENHR analysis, Pareto chart.

MATERIAL AND METHODS:

Permission of the Institutional ethics committee was obtained for accessing the secondary data on the inborn early neonates from Cheluvamba hospital, Mysore. A total of 24,578 live births were monitored for their morbidity status in the NICU unit of the hospital from September, 2011 to June, 2013. It was a secondary source data. However, a census method of data collection was used as all the data during the period were considered. Month wise morbidity causes was detected. Sample 1 was that of the September 2011, Sample 2 being that of October 2011 and so on. The health status was detected from ENHR. Its behavior was observed by plotting ENHR values retrospectively on the time scale using ENHR graph. In this connection, ENHR scale and graphing procedure have been explained. The main causes of morbidity status were detected through Check sheet and Pareto chart^[5]. The statistical analysis and graphs used in this paper were developed using R and Systat softwares.

RESULT:

ENHR is defined as a ratio of “total number of morbidity causes among early neonates in a given area and time to the number of live births in the same area and time”.

The scale of ENHR is defined as

$$ENHR = \begin{cases} 0 & \rightarrow \text{Healthy community} \\ (0,1) & \rightarrow \text{Moderate Health} \\ \geq 1 & \rightarrow \text{Diseased community} \end{cases}$$

The combination of ENHR graph, Check sheet and Pareto chart is called ENHR analysis. ENHR graph is the graph between Time vs ENHR values that indicates the timely ill health. Red, blue and green lines are shown at ENHR values 1, 0.5 and 0.25 respectively and black dotted centre line for mean ENHR value.

According to the central limit theorem in statistics, whatever may be the distribution if the sample size is large then the sampling distribution of mean follows normality. In view of this, it is observed from Table 1 that the mean ENHR is 0.115 with standard deviation 0.028 and standard error of mean 0.006. These statistical techniques are good estimators provided ENHR follows normality assumption. As a result the normality test is done through Shapiro-Wills statistic (SW) test for normality and is passed at 5% level of significance (SW statistic = 0.761, p-value < 0.005). The mean is represented by the dotted black line in figure 1. The ENHR with respect to sample number 8 is 22.2%, being the worst health among the samples considered. Sample number 3 shows ill health to the extent of 14%. Sample 4 i.e. for the month of December, 2011 indicates the better health at 8.3%. From figure 1 it is observed that most of the values are closer to the dotted centre line. Table 2 suggests that HIE/Moderate-severe birth Asphyxia (33%) is the major contributor to the morbidity profile, followed by Sepsis/Pneumonia/Meningitis (15.6%), Respiratory Distress Syndrome (13.4%) and Jaundice requiring phototherapy (12.6%). Figure 2 indicates that these three causes contribute 74.4% to the total number of causes in early neonates.

DISCUSSION:

The exposures, predictors, potential confounders, and effect modifiers were not looked into. Outcomes of this paper were the formula for ENHR, its range and method of graphical analysis.

It is customary in medical field to analyze the health status of a community through morbidity rates. However, incidence or prevalence provides the health status based on the patients as a whole rather than the number of morbidity causes present in the patient. In fact a patient will have at least one cause. As a result, the number of causes present in a patient gives more information on the health aspect of a patient rather than the patient taken as a whole and is even more meaningful at the community level as morbidity causes are more informative than just a disease. In connection with this, the usual morbidity rates miss out the significant information from the patient to explain the health status. There are many practical situations in which doctors prefer to work directly with the morbidity causes rather than the diseases or patient as a whole. These include number of symptoms for a disease, number of ailments in a patient etc.

In view of the above, it is meaningful to study the morbidity status of an early neonatal community. However, this is achieved through a new approach called ENHR analysis.

ENHR is defined as a ratio of “total number of morbidity causes among early neonates in a given area and time to the number of live births in the same area and time”.

$$ENHR = \frac{\text{Total number of morbidity causes among early neonates in a given area and time}}{\text{Total number of live births in the same area and time}}$$

Observe that ENHR is a function of number of causes, hence it is a better health indicator compared to usual morbidity rates. Lesser the value of ENHR better is the health.

Also notice that “number of causes” in an early neonate community is always positive, and the fact that it can exceed the number of live births, the ENHR is always positive and can exceed 1. In view of this ENHR scale is defined as follows:

$$ENHR = \begin{cases} 0 & \rightarrow \text{Healthy community} \\ (0,1) & \rightarrow \text{Moderate Health} \\ \geq 1 & \rightarrow \text{Diseased community} \end{cases}$$

The healthy early neonate community is very rare as early neonates are more prone to infection. $ENHR \in (0, 1)$ indicates lesser the value lesser is the ill health. As ENHR move toward 1 it sends a warning message to early neonate community that it is at risk. Doctors must be on their guard when $ENHR \geq 1$.

Table 1 gives the point ENHR values computed for the early neonates of Cheluvamba Hospital in Mysore. It was developed based on the secondary data. This data was created by the qualified doctors in the NICU unit and maintained by the Medical record section of the government teaching hospital. Hence the potential bias was not known in this case.

Point ENHR is used to know the routine health status of the community whereas the Period ENHR is useful to know the health status in the long run. Data were collected for the 22 month period from September 2011 to June 2013. Sample 1 being that of September 2011, Sample 2 being that of October, 2011 and so on. Sample number 9 corresponding to May, 2012 had 0.2219 ENHR was the most affected month. December, 2011 had the best health indicator with 0.083. These numerals are well supported by the ENHR graph given in figure1. The mean ENHR is 0.115 with standard error of mean 0.006 which is precise enough.

Construction of ENHR graph is as follows. It is constructed for time or sample number against the corresponding ENHR values with horizontal red line at health status (or ENHR value) equal to 1. The green and blue lines are drawn at 0.25 and 0.5 ENHR values respectively. These lines represent the level of seriousness of health status. The region above the red line is the danger zone. Danger zone represents the diseased community. The dotted centre line is the line corresponding to ENHR mean value. The region between centre line to 1 represents the moderate health zone. The area between centre line to zero line represents the better health zone. From figure 1 the line corresponding to mean ENHR (= 0.1131) is the centre line. So long as the centre line is closer to the zero line the health is better. If the ENHR curve is more volatile around the centre line or moving towards the green line, it is an indication of the extent of disturbance in the moderate community health. This means that the number of morbidity causes is spreading across or increasing among the early neonates. From figure 1, ENHR values for sample number 9 is very close to the green line indicating the loss of control over the morbidity causes. The rest of ENHR values seem to be closer to centre line suggesting other samples behave normally with little variation. 60% of the samples lie in the better health region. Thus the early neonatal community of the hospital has fewer health issues, in the sense that the curve is being closer to the centre line.

If ENHR curve moves towards the red line crossing blue line, it is an indication to the society that the early neonate community is really at risk and hence the triggering morbidity cause needs to be detected and tackled to improve the health status.

The triggering cause can be detected using the Check sheet and Pareto chart approach ^[6,7]. The combination of ENHR graph, Check sheet and Pareto chart is called ENHR analysis. It is meaningful to know the reason behind the existing variation in the health status of an early neonatal community. Table 2 provides the check sheet. HIE/Moderate-Severe Birth Asphyxia contributes 32.88% to ENHR variations. According to the Pareto chart in figure 2, which is also called 80:20 chart, in the sense that major ENHR variation denoted by 80% is due to 20% of vital few morbidity causes, 74% of the morbidity is caused by the first three causes namely HIE/Moderate-severe Birth Asphyxia (914), Sepsis/Pneumonia/Meningitis (434), and Respiratory Distress Syndrome (372). Thus, the health status of early neonatal community can be improved by addressing the causes one by one, major being HIE/Moderate-severe Birth Asphyxia.

The cause wise ENHR is not computed as it becomes a specific ENHR. This comes out as a corollary to the more general ENHR defined earlier. The purpose of specific ENHR is to prioritize the cause as it depends on the frequency of cause as mentioned in Table 2, however this is achieved through ENHR analysis. It not only prioritizes the causes but it also provides warning to the health care system regarding early neonate society.

This paper has come out as an answer to the limitations in mortality and morbidity rates concepts. The only limitation of this paper is that the ENHR depends on the measurement system of morbidity causes. The finer the measurement system the better is ENHR.

Table 1: Table representing the ENHR values of early neonates of Cheluvamba Hospital, Mysore

Sample number	Month	Sample size (No. of live births)	Number of morbidity causes	ENHR
1	September, 2011	938	110	0.117
2	October, 2011	891	121	0.136
3	November, 2011	990	139	0.140
4	December, 2011	1128	94	0.083

5	January, 2012	1057	99	0.094
6	February, 2012	1302	159	0.122
7	March, 2012	1137	111	0.098
8	April, 2012	1175	146	0.124
9	May, 2012	739	164	0.222
10	June, 2012	1108	133	0.120
11	July, 2012	928	124	0.134
12	August, 2012	977	103	0.105
13	September, 2012	1056	94	0.089
14	October, 2012	1135	119	0.105
15	November, 2012	1066	106	0.099
16	December, 2012	1306	165	0.126
17	January, 2013	1228	136	0.111
18	February, 2013	1171	132	0.113
19	March, 2013	1376	130	0.094
20	April, 2013	1355	138	0.102
21	May, 2013	1160	118	0.102
22	June, 2013	1355	138	0.102

Inference: ENHR with respect to sample number 9 was 22.2%, the worst among samples considered. Sample number 3 was 14% ill health. Sample 4 i.e. for the month of December, 2011 had the best health at 8.3%. The mean ENHR was 0.115 with a standard deviation 0.028 and a standard error is 0.006.

Table 2: A check sheet showing morbidity causes in early neonates.

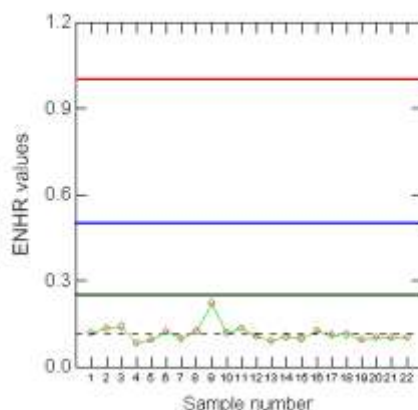
Project: Early Neonatal health status check Name: Cheluvamba hospital			
Location: Mysore		Date: Sept 2011 to June 2013	
Morbidity Causes	Frequency	Relative Frequency	Cumulative Relative Frequency
*HIE/Moderate-Severe Birth Asphyxia	914	0.328895	0.328895
Sepsis/Pneumonia/ Meningitis	434	0.156171	0.485066
Respiratory Distress syndrome	372	0.133861	0.618927
Jaundice requiring phototherapy	349	0.125585	0.744512
Others	275	0.098956	0.843469
Meconium aspiration syndrome	263	0.094638	0.938107
Major Congenital Malformation	92	0.033105	0.971212
Other causes of respiratory distress	26	0.009356	0.980568
Hypoglycemia	45	0.016193	0.996761
Hypothermia	9	0.003239	1
Total	2779		

*Hypoxic Ischemic Encephalopathy (HIE)

Inference: From the above table it was seen that HIE/Moderate-severe birth Asphyxia (33%) was the major contributor to the morbidity profile, followed by Sepsis/Pneumonia/Meningitis (15.6%) Respiratory Distress Syndrome (13.4%) and Jaundice requiring phototherapy (12.6%). These four contribute 74.4% in total to the number of causes in early neonates.

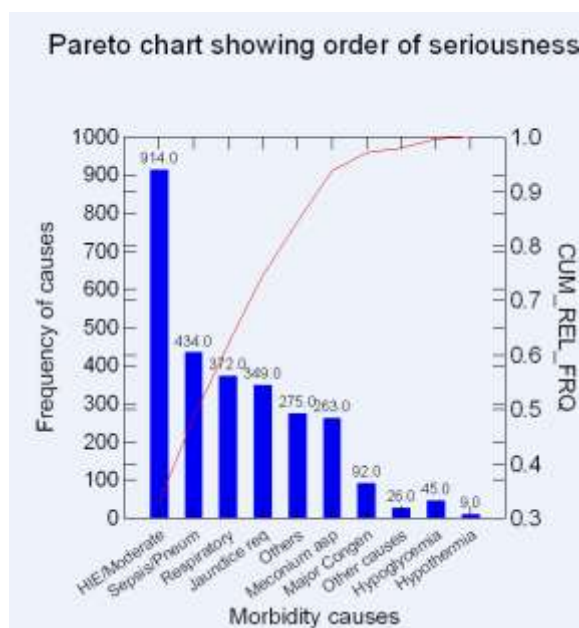
Figure 1:

ENHR graph showing morbidity pattern of Early Neonates



Inference: Red, blue and green lines indicate the level of seriousness. The red line shows the danger mark. The red line is marked at 1, blue at 0.5 and green line at 0.25 ENHR values. Sample 9 had ENHR value 0.22 very near to the green line. All values are closer to the dotted centre line.

Figure 2:



Inference: The above chart indicates that 74% of the morbidity is caused by the first three causes viz HIE/Moderate-severe Birth Asphyxia (914), Sepsis/Pneumonia/Meningitis (434), and Respiratory Distress Syndrome (372).

CONCLUSION:

This study speaks about the new approach by developing a concept called ENHR for understating the morbidity of early neonates. We conclude that a graphical approach called ENHR analysis can be used effectively in the hospitals for the early neonatal community (in general for any community) in recognizing the health status pattern and hence detecting the major causes of morbidity. However, it is recommended to take the decision on the major causes considering the impact of morbidity factors on the early neonatal mortality too.

REFERENCES:

1. Wallace/Maxcy- Rosenau-Last. Text book of public health and preventive medicine. Mc Graw Hill: 15th ed; 1294.
2. Detels, Mc Ewen, Beaglehole, Tanaka. Oxford textbook of Public Health. Oxford press: 4th ed; 1604-1607.
3. Park, K. Preventive and Social Medicine. M/s Banarsidas Bhanot publishers: 21st ed; 521.
4. Montgomery D C. Introduction to Statistical Quality Control. New York: John Wiley & Sons: 3rd ed; 1996; 314.
5. Ishikawa K. Guide to Quality Control. Tokyo, Japan: Asian Productivity Organization: 1982; 225.
6. Shewhart WA. Economic Control of Quality of Manufactured Product. Van Nostrand; 1931.
7. Vadiraja N, Mansoor Ahmed, Mudassir Azeez Khan, Krishnamurthy B, Anagha R. A study of neonatal service quality in a government teaching hospital of Mysore district, India. International journal of medical and applied sciences 2013; 2 (3):80-87.